Forced stimulation method for lambda regulation for IC engine with catalyzer has weak/rich amplitude values superimposed on lambda required value

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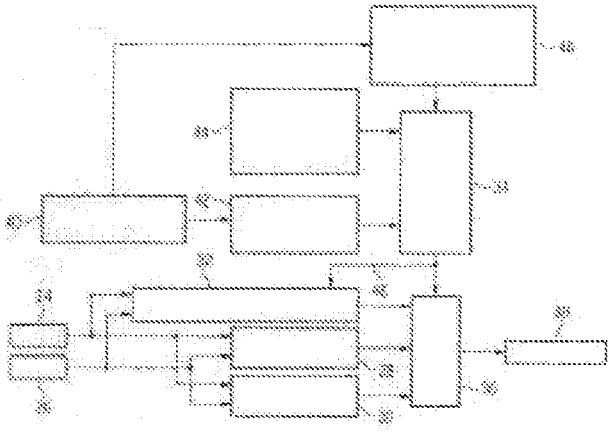
Abstract of **DE 10206399 (C1)**

The forced stimulation method has 2 different weak/rich amplitude values superimposed on the lambda required value during successive sets of exhaust packets, the regulation device determining the second amplitude value and a component of the second exhaust packet set, so that the signal values provided by the lambda probe on the downstream side of the catalyzer are altered.



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The instant invention concerns a method for the suggestion for obligation of a Lambdaregelung for an internal combustion engine with a catalyst, upstream as well as downstream from this disposed Lambdasonden and a controller.

New guidelines for exhaust reduction make during the emission control a necessary for increased effort. In the article of Cornelius et al. "The Role OF Oxygen STORAGE in NO Conversion into automotives Catalysts", which was handed as Pre print to the documents, becomes described that becomes achieved by a suggestion for obligation a better exhaust conversion. During the suggestion for obligation a Lambda target value a fat becomes /Mageramplitude superimposed. The known suggestion for obligation is symmetrical to a Lambda target value.

From DE 43 44 892 C2 is obligatory a control air/fuel of mixture known, the independent from the operating condition between enriched and lean states oscillated, in order to increase the cleaning efficiency of the catalyst.

From DE 198 44 994 A1 is a method to the diagnosis of a steady Lambdasonde known. With the method the target value for the Lambdaregelung is copied by periodic suggestions for obligation impressed and the distance behavior of the Lambdaregelungskreises by means of a model. The amplitude reinforcement of model and system become compared with one another and dependent of the result of comparison of the model parameters adapted. If the change of the model parameter lies above a threshold value, then the Lambdasonde becomes as defectively classified. The superimposed amplitude is symmetrical to the Lambda target value and fat one as well as lean-flat same itself out.

From DE 195 16 239 is a method for parameterizing a Lambdaregelungseinrichtung known. Approach for parameterizing is that the transfer function of the Lambdaregelstrecke can become shown as a serial connection of two delay elements of first order and a lag element in the Lamdaregelkreis. The air number average value becomes controlled over a PID controller. The determination of the distance parameters made here dependent of a probe output signal of a linear Lambdasonde.

With a Lambdaregelung generally assumed become that an optimum conversion is predetermined with a signal value of the Lambdasonde downstream disposed of a catalyst dependent of the operating point. Since the conversion of the catalyst of its history is dependent, it can come with the control to a slow way drifting of the conversion rate, without this by the signal value of the downstream located catalyst displayed becomes.

The invention is the basis the object to make a suggestion for obligation available which avoids a reliable deterioration of the exhaust conversion with simple means.

The object becomes according to invention by methods with the features from claim 1 a dissolved. Advantageous embodiments form the subject matter of the Unteransprüche.

The invention process proceeds from a so called fine dosage of the exhaust gas composition. For this a Lambda target value during a suggestion for obligation for a first number of exhaust packages a first amplitude becomes and for a second number of exhaust packages at least two different second amplitude values superimposed. The controller certain one of the second amplitude values and an associated portion of the second exhaust packages in such a manner that the signal values of the downstream located Lambdasonde change due to these exhaust packages. Prefered one becomes a reversal of the signal values achieved. With the help of the suggestion for obligation a good optimization of the exhaust gases becomes achieved with the invention process. Simultaneous one becomes by the additional second amplitude value targeted affecting of the signal values downstream of the catalyst located Lambdasonde achieved (claim 2). With the invention process a made targeted stimulation of the Lambdasonde downstream located of the catalyst, the one creeping way drifting of the conversion rate prevented.

The direction reversal of the signal values made prefered by inclusion or removal of fat or lean exhaust packages. It becomes a operating point-dependent direction reversal effected, which repeat themselves in regular or irregular timed distances. As the number of the lean exhaust packages becomes varied, the freedom remains to the controller to determine the number and the Lambdawerte of the remaining suggestion for obligation corresponding reading and speed-sensing from the operating point to (claim 3, 4).

The Lambdawert determined over the first number and the second number of the exhaust packages, corresponds to the Lambda target value (claim 5). Prefered ones are here both second amplitude values leaner (claim 6).

In a prefered embodiment of the invention process the first and second number of the exhaust packages is a multiple one of the number of cylinders, which are in an exhaust strand with a catalyst provided. The advantage lies in the fact that cylinder inequalities become out-averaged into the Lambdawerten and that the exhaust gas composition over the period duration (claim 7).

In order to increase the accuracy during the suggestion for obligation and the conversion still more other, the signal values of the downstream located catalyst become averaged over first and the second number of exhaust packages (claim 8).

For the so averaged signal values checked becomes whether a direction reversal of the signal values becomes achieved by one of the second amplitude values.

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The invention process becomes subsequent more near described on the basis an embodiment. It shows:

Fig. 1 the amplitude values for the suggestion for obligation and

Fig. 2 a schematic expiration operational sequence to the determination of the amplitude values.

Fig. 1 shows the amplitudes of the suggestion for obligation in accordance with an embodiment of the invention process. In Fig. 1 is the course the DELTA_LAMBDA_WERTE plotted, which become a Lambda target value added. The suggestion amplitude is against the time in

milliseconds plotted. Curve 10 shows the course of the amplitude values during the conventional suggestion for obligation. Curve 10 possesses an approximate sinusoidal course, with the fat/lean amplitudes over rising and/or. falling edges turn into. In the represented example the known suggestion for obligation possesses a suggestion amplitude of approximate 0.030 and a period duration of approximate 850 ms.

The amplitude process after the invention process is exemplarily in curve 12 shown. In a first period 14 the amplitudes become 16 and 18 predetermined for the lean excitation. Alternative two amplitude values different to the use can become also different numbers of exhaust packages used. In the represented example the amplitude value 18 is larger, D. h. the resultant lambda is lean as with the amplitude value 16. In the subsequent period 20 a first amplitude value becomes 22 subtracted of the Lambda target value. The Lambda target value is here less fat than one of the two amplitude values 16 and 18. The durations of the excitation 14 and 20 are in the represented embodiment approximate same prolonged.

The sequence of the three amplitude values 16, 18 and 22 repeated itself, whereby the durations of the amplitude values 16 and 18 varied. In the represented example the duration of the lean amplitude becomes 18 shortened in the three successive periods.

The duration of the amplitude values 18 becomes bottom observation of the NAK HC-RK probe signal certain. Thereby an effective conversion becomes possible by the catalyst, without so called "falling asleep" of the catalyst arises or an oxygen break-through.

Fig. 2 points in a schematic block diagram the process steps to the determination of the suggestion amplitude. As inputs 24 and 26 lies close the current values for the speed and load. The input values 24 and 26 rest in each case against the computation modules 28 and 30. Here calculated module 28 the value for the first lean suggestion amplitude 16 (IP_DE_LAMB_SP_AFL). The second computation module 30 the calculated value for the suggestion amplitude 22 in the phase of the fat Lambdawerte (IP_DE_LAMB_SP_AFR). The module 32 the calculated value for the second lean amplitude 18 (IP_DELTA_LAMB_AFL_COR). Additional one to the response of load and speed depends the calculation of the second lean amplitude on the output signal of exhaust control equipment 34.

The output signals of the units 28, 30, 32 rest against a switch 36. The switch 36 continues to switch dependent from the output signal of the exhaust control equipment 34 one of the lying close input signals as Lambdaausgangssignal 38.

As other input for the suggestion for obligation the signal value of the signal values 40 the Lambdasonde fits downstream from the catalyst, the so called NAK HC-RK signal. Dependent of the input 40 the number of the segments certain becomes in a module 42, in which the amplitude value 18 is to lie close (IP_SEG_NR_AFL_COR). With the default of the Semgentzeit 44 a gradzahliges multiple one of the number of cylinders becomes and/or. a cylinder bank selected. Furthermore because of the exhaust control equipment 34 are the constants for the number of the lean segments (C_SEG_NR_AFL) and the fat segments (C_SEG_NR_AFR) on. The sum of the segment numbers of the certain frequency of the suggestion for obligation, whereby the duration with fat and lean amplitude can be different.

In the model 46 the development of the catalyst signal becomes 40 monitored. The monitoring made for example going by whether deviations arise into the catalyst signal 40 over several periods. Likewise the catalyst signal can become 40 on a threshold value monitored. The output of the monitoring unit 46 rests against the exhaust control equipment 34, so that in the case of deviation in the catalyst signal 40 the controller 34 can switch the three amplitude values corresponding.

The output signal 48 of the exhaust control equipment 34 rests to additional against the module 32, so that the determination of the amplitude value 18 dependent from the catalyst signal 40 can take place.

For example rises after a Durchfetten due to an acceleration of the NAK HC-RK probe signal levels (VLS_DOWN). An optimum for the conversion is with a control due to the signal values of the downstream located catalyst dependent of the history of the Katbeladung, so called MEMORY effect. After very fat loading for example the possibility exists that with signal values of the catalyst it comes to emission degradations, which do nôt arise with normal operating states. With this effect sudden NOx breakthroughs can to arise be able. During pure operating point a dependent constant value control for the Lambdawerte, becomes neither this MEMORY effect considered, nor a slow way drifting of the conversion rates calculation can become supported. With the obligation dosage according to invention, during the one fine dosage of the exhaust gas composition made, the signal of the downstream located catalyst becomes regular stimulated. For example if the signal value of the downstream located catalyst sinks from an evaluation cycle to the next, then the oxygen content in the exhaust gas becomes reduced. If rising changes arise between the evaluation cycles, then the oxygen portion in the exhaust gas becomes increased. If the change of the downstream located Lambdasondenwerte is smaller as zero over a number of steps, then with a predetermined number a reversal of the signal values will exceed predetermined and reacted by a changed exhaust gas composition. If this rising of the level is made, the subsequent signal values in same type become other-lowered, until a predetermined minimum value becomes achieved. This minimum value is exceeded upward and downward by targeted exhaust fine dosage and again in phase brought, in order to avoid a way drifting of the signal values.